Form ESA-B4. Summary Report for ESA-096-3
Public Report - Final

Company	Jeffboat	**ESA Dates**	12/17/2008 – 12/19/2008
Plant	Jeffersonville IN	**ESA Type**	Compressed Air
Product	Barges, tankers	**ESA Specialist**	Kelly Kissock

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

Jeffboat builds barges (hoppers), chemical carriers, tankers and other large boats. It is the largest inland shipyard in the U.S. The plant stretches over 64 acres along the Ohio River. The plant can produce eight barges per week, two chemical carriers per week or one tanker every two weeks. The plant operates 24 hours per day, 365 days per year. However, production activity slows during inclement weather.

The plant uses about 32,482,692 kWh/year in electricity at an average cost of $0.052 /kWh for a total cost of about $1,659,924 /year. Monthly electricity use varies from a peak of about 3,179,000 kWh/month during winter to a low of about 2,235,000 kWh/month during summer.

The plant employs 10 lubricated, air-cooled, rotary-screw, Gardner Denver air compressors to supply air to 5 separate compressed air systems. All of the compressors are located outdoors or in open sheds. Total air compressor electricity use is about 9,522,120 kWh/yr costing about $495,150 /year, which is about 29% to total plant electricity use and cost. The air compressors, measured power draw and estimated compressed air output are summarized in the table below.

Air Compressor Summary Table

Yard	Comp	Comp HP	Fan HP	P (psig)	Control	kWin	hp_out	net hp_out	FP	FC	C scfm	Out scfm
336	Riverside	200	5	82	ConsRun	152	187	183	0.92	0.812	840	682
336	Streetside	200	5	85	ConsRun	165	203	199	1.00	0.993	840	834
260	250-hp	250	10	80	ConsRun	118	146	138	0.55	0.005	1,050	5
204	Upriver	200	5	85	ConsRun	110	135	131	0.66	0.238	840	200
204	Downriver	200	5	86	ConsRun	183	226	222	1.11	1.244	840	1,045
	Total	1,050				727					4,410	2,766
Plate Shop	**Comp**	**Comp HP**	**Fan HP**	**P (psig)**	**Control**	**kWin**	**hp_out**	**net hp_out**	**FP**	**FC**	**C scfm**	**Out scfm**
123	100-hp	100	5	125	ConsRun	87	107	104	1.04	1.079	420	453
123	15-hp	15	0	121	Auto	0	0	0	0.00	-1.222	63	0
	Total	115				87					483	453
ShotBlast	**Comp**	**Comp HP**	**Fan HP**	**P (psig)**	**Control**	**kWin**	**hp_out**	**net hp_out**	**FP**	**FC**	**C scfm**	**Out scfm**
123	250-hp	250	7.5	99	LowDem	162	200	194	0.78	0.501	1,050	527
Barn	**Comp**	**Comp HP**	**Fan HP**	**P (psig)**	**Control**	**kWin**	**hp_out**	**net hp_out**	**FP**	**FC**	**C scfm**	**Out scfm**
Barn	75-hp	75	3	120	ConsRun	58	72	69	0.92	0.830	315	262
Sidebox	**Comp**	**Comp HP**	**Fan HP**	**P (psig)**	**Control**	**kWin**	**hp_out**	**net hp_out**	**FP**	**FC**	**C scfm**	**Out scfm**
218	75-hp	75	3	105	ConsRun	52	64	61	0.82	0.597	315	188
Totals		1,565				1,085					6,573	4,195

Logged pressure from the yard system and current draw from five of the primary air compressors over an 18 hour period are shown in the Logged Data section. The data show that all compressors operate in "constant run" mode in which compressed air output is controlled by modulating the air inlet valve. The data also show that compressed air use does not decrease during third shift despite rainy conditions that stopped most production. This indicates a very large leak load.

Objective of ESA:
The objective of this energy saving assessment (ESA) was to assist plant personnel in reducing compressed air operating costs by:

- Training plant personnel in compressed air system energy efficiency fundamentals
- Training plant personnel in the use of Air Master+
- Assisting plant personnel in identifying and quantifying energy saving opportunities.

Focus of Assessment:
The ESA focused on evaluating compressed air end uses, distribution system and plant for energy efficiency opportunities.

Approach for ESA:
The approach for this assessment was to:

- Discuss DOE and company objectives for the assessment.
- Inspect compressed air end uses, distribution and plant.
- Discuss energy saving opportunities for compressed air systems.
- Identify energy saving opportunities in the plant.
- Demonstrate the use of Air Master+.
- Develop an Air Master+ model of the compressed air system at the plant
- Quantify savings opportunities.
- Share and discuss savings opportunities.

General Observations of Potential Opportunities:
We identified the following assessment recommendations (ARs).

AR-1: Fix Leaks and Repair/Replace Condensate Drains
Logged data show that compressed air use does not decrease during third shift despite rainy conditions that stopped most production. This indicates a very large leak load. Compressed air lines run underground throughout the plant. Many of these lines leak. After a rain created puddles on the ground, bubbles clearly indicated two leaks. Once above ground, compressed air fittings are subject to abuse from the extremely heavy materials transported throughout the yard. In addition, outside conditions make leaks less noticeable. Several large leaks were identified at fittings throughout the plant.

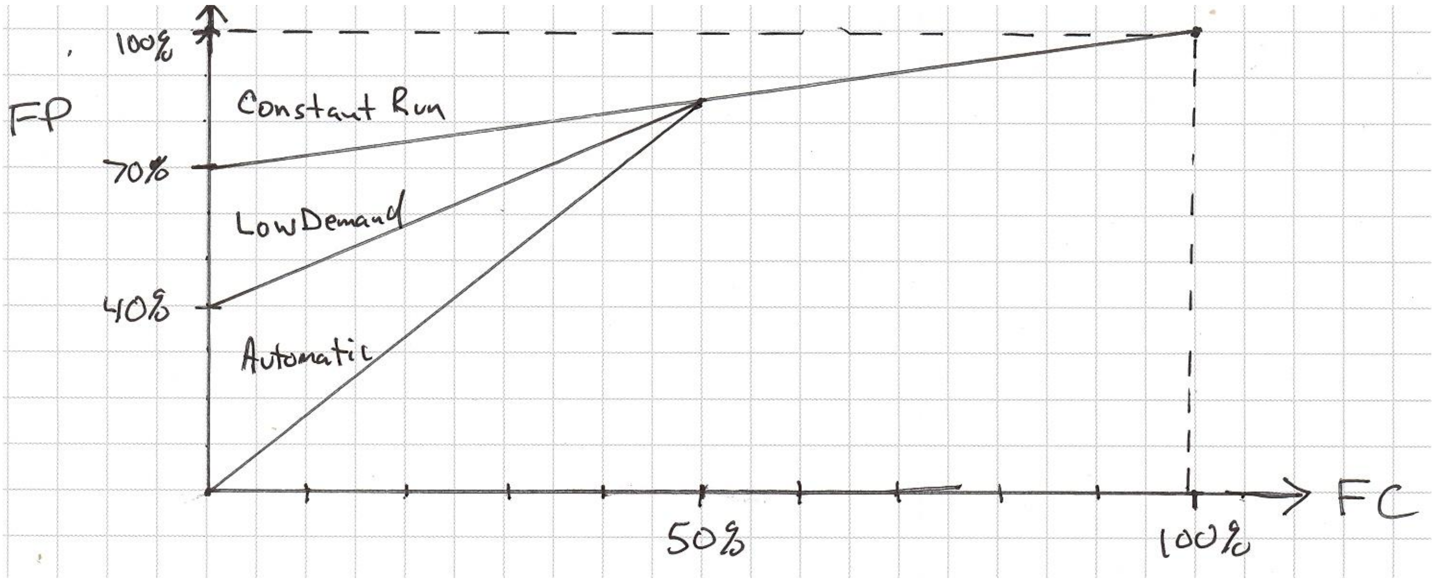
All compressors have large condensate drains with timed solenoids just down flow of the after-coolers. When working timed solenoids drains generally discharge far more compressed air than necessary since they are generally set for worst case conditions (hot, rainy days) which occur infrequently. Even worse, some of the condensate drains were malfunctioning, and compressed air was constantly discharged to remove the condensate. The timed solenoids on other drains were completely turned off, which causes excess water in the lines. The best solution to remove water and minimize compressed air use is to install “automatic” drains. Automatic drains function like steam traps, and only allow discharge condensate when it builds up. Doing so would provide dryer air to the yard and reduce compressed air use.

Based on the logged data and observations, we estimate that compressed air use could be reduced by 1,500 scfm with an aggressive leak detection and repair program. If so, the savings would be about 1,053,421 kWh/year and $54,778 /year. (See AR-4 for savings from fixing leaks AND changing control modes)

AR-2: Turn Off Bldg 260 Compressor Except During High Production
Measured power draw of the building 260 compressor in the Air Compressor Summary Table shows that it is only about 55% loaded and producing negligible compressed air. We recommend turning it off except during high demand periods. Management agreed that it could and should be turned off. Assuming it is turned off 80% of the time, the savings would be about 1,054,456 kWh/year and $54,832 /year.

AR-3: Reset Bldg 204 Upriver/Downriver Compressors to 82/85 psig and Operate in Automatic Mode
Measured power draw of the building 204 upriver and downriver compressors in the Air Compressor Summary Table shows that the upriver compressor is lightly loaded and the downriver compressor is fully loaded. This is because the set-point pressures are slightly staged with the upriver compressor set at 85 psig and acting as the trim compressor and the downriver compressor set at 86 psig and acting as the base load compressor. Although this is effective, we recommend a setting the pressures of the upriver and downriver compressors to 82 and 85 psig respectively, to ensure staged operation. If the compressors were then set to run in Automatic Mode, the upriver compressor would seldom turn itself on. Assuming the compressor turn on 12% of the time, the savings would be about 1,093,782 kWh/year and $56,877 /year.

AR-4: Run All Compressors in Automatic Mode and Add Storage Tanks
Gardner Denver compressors can operate in three control modes: Constant Run, Low Demand and Automatic. In Constant Run mode, compressed air output is controlled by modulating the air inlet valve. This is the least energy efficient control mode; at zero compressed air output the compressor is still drawing about 70% of full load power. In Low Demand mode, when compressed air output falls below 50% capacity, the compressor loads and unloads. Unloaded, it draws about 40% of full load power. Thus, this is more energy efficient than Constant Run mode. In Automatic mode, the compressor will automatically turn itself off if it runs unloaded for more than 5 minutes, and automatically restart itself when needed. This is the most energy efficient operating mode. The relationship between fraction power and fraction capacity for these modes is shown in the figure below.



Currently, all compressors operate in “Constant Run” mode. We recommend changing all compressors to “Automatic Mode”, even if this means refurbishing controls or installing automatic shutoff on some older machines. In addition, this may involve installing compressed air storage tanks near the compressors without storage tanks. The storage tanks will extend the load/unload period and prevent over-cycling. To store 1 minute of air for a 100-hp compressor, each tank should be about 4,000 gallons, which is about the same size as the existing 3 ft x 10 ft tanks.

Savings from operating compressors in Automatic Mode would be small if compressed air demand is not reduced. However, the savings from reducing compressed air use by 50% and operating in Automatic mode would be about 2,715,658 kWh/year and $141,214 /year. Thus, the net savings (AR-4 savings less AR-1 savings) from changing control modes can be estimated at 1,662,237 kWh/year and $86,436 /year.

Total Savings:
We estimate that total savings from implementing these recommendations would be about 4,863,896 kWh/year and $ 252,923 per year. These savings represent about 51% of total air compressor energy use and 15% of total plant electricity use.

Management Support and Comments:
"Kelly was great. Thanks."
"Very knowledgeable of air systems and opportunities for savings."
“You have already been of great help.”
“We already turned off compressor 260 and set all the compressors to “Low Demand” or “Automatic”.
“We had a compressed air study done previously. This verified our ideas.”
“We have a work order in place to fix the leak near building 123.”

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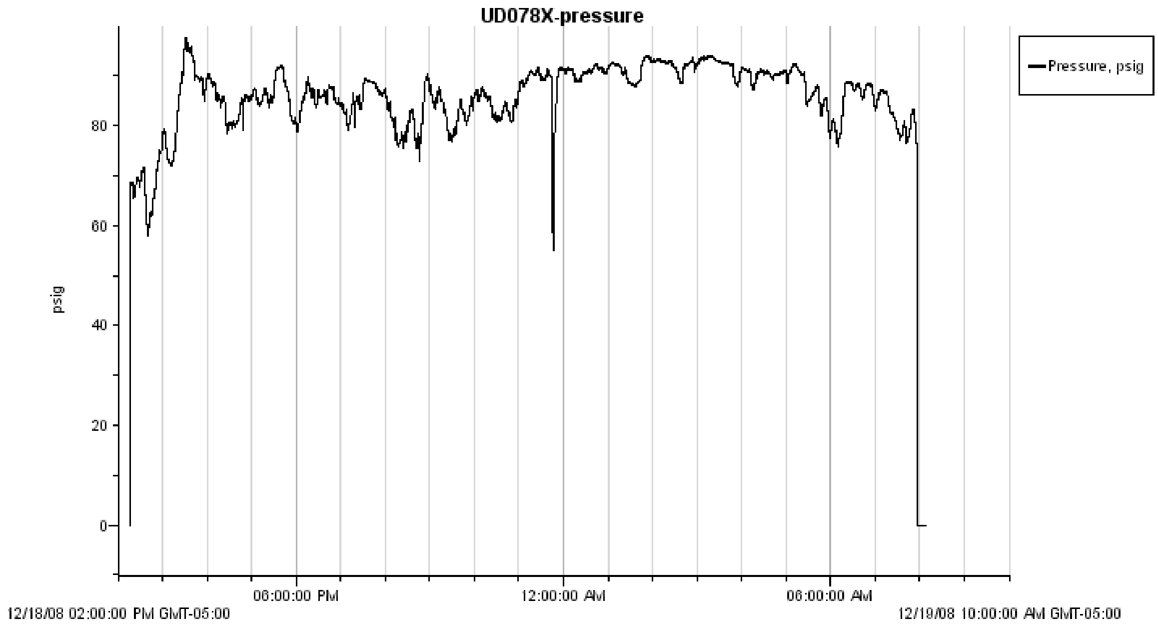
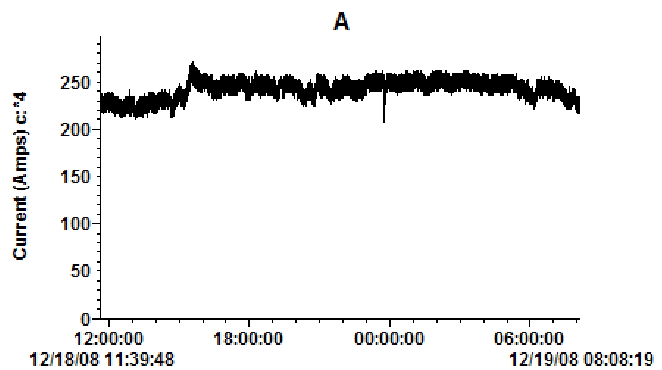
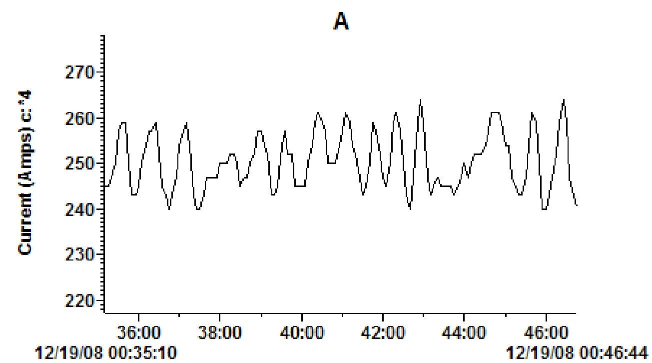
Logged Pressure and Current Data:



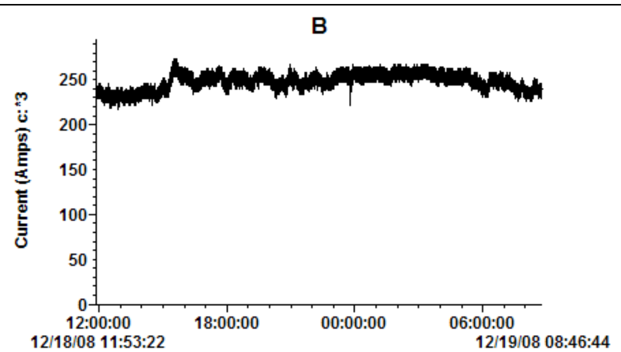
Yard System Pressure Measured at Maintenance Garage



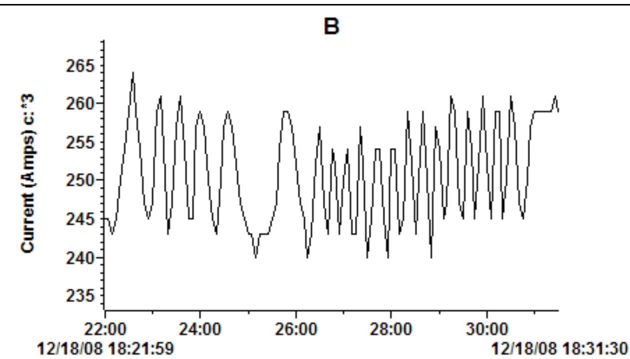
Bldg 336 Riverside



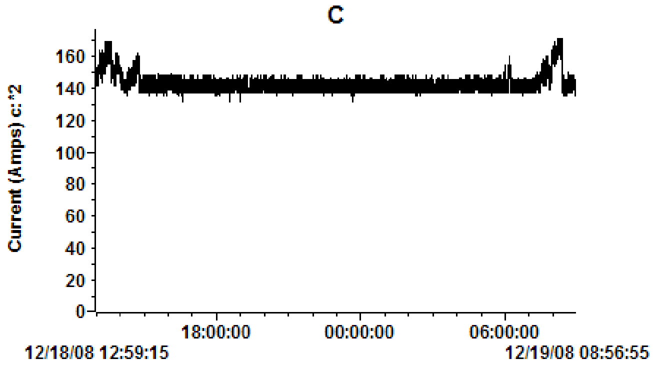
Bldg 336 Riverside



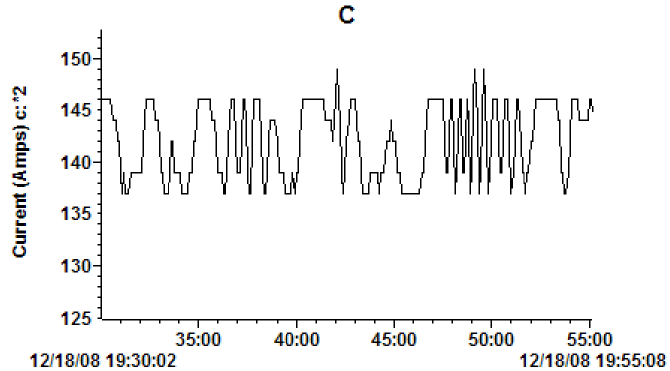
Bldg 336 Streetside



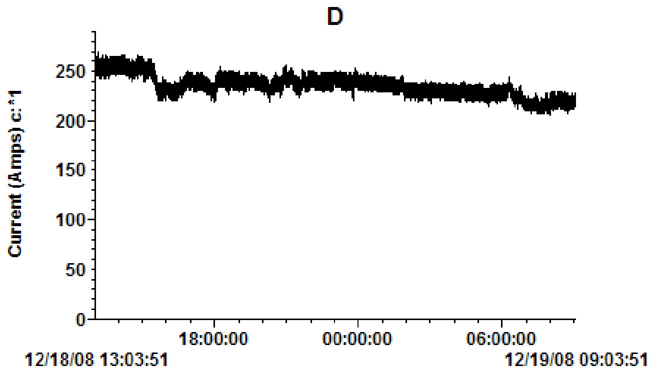
Bldg 336 Streetside



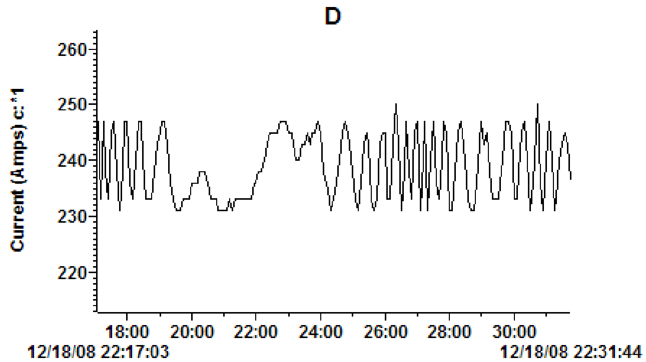
Bldg 204 Upriver



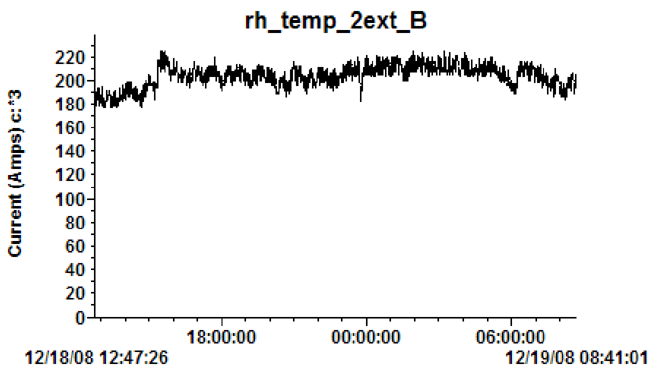
Bldg 204 Upriver



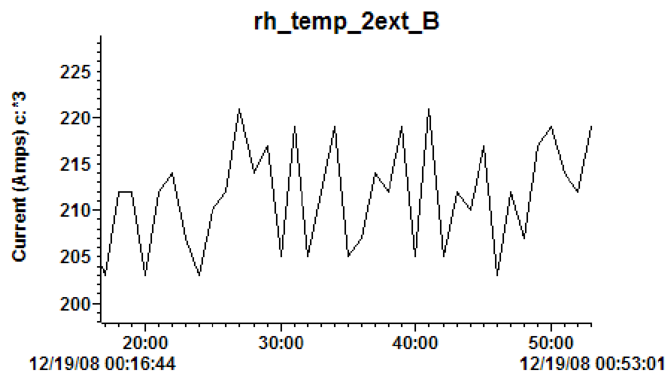
Bldg 204 Downriver



Bldg 204 Downriver



Bldg 260



Bldg 260